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RIVER PROTECTION PROJECT – WASTE TREATMENT PLANT

ENGINEERING SPECIFICATION

FOR

Plate and Frame Heat Exchangers

DIM No.
 24590-WTP-3PI-MEP0-00001

Rev
 0

DOE Contract No.
 DE-AC27-01RV14136

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SPECIFICATION No.
 24590-WTP-3PS-MEP0-T0001

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1 Scope

This specification supplements the *RPP-WTP Specification for Pressure Vessel Design and Fabrication* (24590-WTP-3PS-MV00-T0001). This specification, together with the purchase order, data sheets, and drawings, covers the requirements for the design, fabrication, and testing of plate and frame heat exchangers for the River Protection Project – Waste Treatment Plant (RPP-WTP) located at Hanford in the southeastern part of Washington State.

2 Applicable Documents

2.1 General

- 2.1.1 Work shall be done in accordance with the referenced codes, standards, and documents listed below, which are an integral part of this specification.
- 2.1.2 When specific chapters, sections, parts, or paragraphs are listed following a code, industry standard, or reference document, only those chapters, sections, parts, or paragraphs of the document are applicable and shall be applied. If a date or revision is not listed, the latest issue, including addenda, at the time of Request for Quote (RFQ) shall apply. When more than one code, standard, or referenced document covers the same topic, the requirements for all must be met with the most stringent governing.

2.2 Codes

- 2.2.1 American Society of Mechanical Engineers, Boiler and Pressure Vessel Code, Section VIII, Division I, Rules for Construction of Pressure Vessels

2.3 Reference Documents/Drawings

- 2.3.1 RPP-WTP Specification for Pressure Vessel Design and Fabrication, 24590-WTP-3PS-MV00-T0001
- 2.3.2 RPP-WTP Specification for Supplier Quality Assurance Program Requirements, 24590-WTP-3PS-G000-T0001

3 Design Requirements

3.1 Basic Requirements

- 3.1.1 Unless otherwise specified, all heat exchangers shall be designed and fabricated in accordance with the ASME Section VIII, Division 1, the *RPP-WTP Specification for Pressure Vessel Design and Fabrication*, and any additional requirements of this specification and the referenced drawings.

- 3.1.2 The Buyer's thermal design requirements will be shown on the individual heat exchanger Mechanical Data Sheet (MDS). When the Buyer's MDS shows the mechanical sizes (nozzle diameters, lengths, or arrangement, etc.), this data shall be considered as preliminary. Seller shall verify the thermal, hydraulic and mechanical designs. Where necessary the Seller shall change the exchanger size in order to furnish complete thermal, hydraulic and mechanical guarantees. Seller shall calculate the heat transfer rate for each unit and base the design on the minimum surface area necessary to guarantee that the heat exchanger offered is satisfactory for the duty specified. Buyer's preliminary design, where specified and if determined to be conservative, shall prevail.
 - 3.1.3 All components in contact with the heat transfer fluids shall be compatible with the material used for the plates. If the material for a component in contact with the fluids is not specified on the MDS, then material selection shall be approved by the Buyer.
 - 3.1.4 The heat exchanger shall be a single pass, countercurrent design with access to the plate pack for maintenance and to enable cleaning by backflushing. A multipass design may be considered as an alternate design.
 - 3.1.5 Flow area of the ports shall be such that the entrance and exit pressure drops combined are not more than 30% of the total calculated pressure drop.
 - 3.1.6 Design shall maximize fluid shear stress between plates, within the pressure drop restrictions, to reduce the fouling rate and produce high heat transfer coefficients.
 - 3.1.7 The maximum velocity through the inlet and outlet nozzles shall be 20 ft/s. Port diameters shall not be less than the nozzle inside diameter.
 - 3.1.8 The design of the heat exchanger shall provide for individual plate removal/replacement without requiring the removal of any other plate(s).
- 3.2 Plates**
- 3.2.1 Seller shall keep to a minimum the number of different types of plates offered unless an appreciable capital savings is realized.
 - 3.2.2 Plates shall be designed for full differential pressure, with one side at the design pressure and the other side at atmospheric pressure.
 - 3.2.3 After pressing, the minimum thickness of plates shall be 0.024 inch.
 - 3.2.4 Plates shall be pressed on a homogeneous sheet in one step. Plates with incremental pressing along its length can be offered as an alternate design.
 - 3.2.5 Each plate shall be permanently marked to identify the type and orientation.
 - 3.2.6 If welded plate pairs are specified on the MDS, welding methods must be detailed in the Seller's proposal.
 - 3.2.7 Design shall be such that metal-to-metal contact exists between adjacent plates.

- 3.2.8 Plate alignment shall be accomplished mechanically with the aid of the carry and guide bars. Designs which require the use of gaskets to achieve satisfactory plate alignment are not acceptable. The use of hanging clips on plates for alignment (round or square carrying bars) is limited to plates of a maximum length of 3 feet.
- 3.2.9 Plates shall be fully supported from the top carrying bar and guided only by the bottom bar. The plates shall have integrally reinforced slots.
- 3.2.10 At each end of the plate pack, end plates shall be furnished to provide sealing of the first and last flow channel and to transmit support from the cover to the adjacent plate.
- 3.2.11 For a multipass design, if approved by the Buyer:
 - Unblanked ports must be designed to withstand full differential pressure without permanent deformation or failure.
 - For ports greater than 6 inches, the turning plate shall be a minimum 0.25 inch thick.
 - Port holes not feeding passes between plates shall be fully gasketed and vented to the atmosphere.

3.3 Covers

- 3.3.1 Single pass counter-current design shall have all nozzle connections located in the fixed cover.
- 3.3.2 The movable cover shall be fully supported from the upper carrying bar by means of roller bearings and guided by the bottom bar.
- 3.3.3 Cover design shall preclude the use of stiffeners.
- 3.3.4 Holes for tightening bolts shall be uniformly distributed along each side of the covers, but top and bottom bolt hole spacing may differ from that on the sides. Exchangers with port sizes 3 inches and larger, or with tightening bolts 1 inch diameter and larger shall have slotted holes and provide a mechanical method for retention of the tightening bolts.
- 3.3.5 All welded attachments to covers, including nameplate brackets, etc. shall be continuously welded to the covers. These welds shall be examined by liquid penetrant method.
- 3.3.6 A removable stainless steel shroud shall be provided by the vendor to completely cover the top and sides of the plate pack.

3.4 Frame, Tightening Bolts and Nuts

- 3.4.1 Unless otherwise noted or approved by the Buyer, the frame and tightening bolts shall be designed to permit the future installation of a minimum of 20 % additional plates.

- 3.4.2 Supports with baseplates shall be furnished at both ends of the frame.
- 3.4.3 The minimum diameter of the tightening bolts shall be 5/8 inch.
- 3.4.4 The stationary end of each tightening bolt shall have a mechanically attached captive nut. Welding of the nut to the tightening bolt is not permitted. A locking device shall be used on one end to prevent bolt rotation during bolt tightening and loosening. Washers shall be provided on each end of the tightening bolt.

3.5 Carrying and Guide Bars

- 3.5.1 Carrying bars and guide bars shall be fabricated from a single length of material. A smooth surface shall be provided for the movable cover roller for the whole length of the carrying bar. Aluminum components are not allowed.
- 3.5.2 The carrying bar shall be designed to support 1.5 times the weight of a flooded exchanger including movable cover, tightening bolts, nuts, and nozzles.

3.6 Connections

- 3.6.1 All inlet and outlet connections shall be raised-face, weld-neck flanges or butt weld construction, as specified on the Mechanical Data Sheet. Nozzle neck attachment to the cover shall be of welded construction.
- 3.6.2 Flanged nozzle projections shall be of sufficient length to allow installation and removal of flange bolting. Butt weld connections shall project at least 8 inches beyond the cover surface.

3.7 Plate Gaskets

- 3.7.1 All gaskets, except between end plates and heads, shall be identical.
- 3.7.2 Gaskets shall be positioned in a groove around the heat transfer surface and around the port holes of the plate. The grooves shall be designed to prevent over/under compression of the gaskets when the plate pack is compressed to its design value.
- 3.7.3 Gasket design shall allow a metal-to-metal contact between plates when the plate pack is compressed.
- 3.7.4 In general, gasket attachment may be glued or nonglued. Nonglued gaskets are preferred for clean services, and glued gaskets are preferred for fouling services.
- 3.7.5 The gasket plate surface shall be thoroughly cleaned by means of solvent cleaning (solvent shall be compatible with the gasket material) or mechanical means and dried before the application of the gasket. Emery cloth or abrasive powders shall not be used to clean the gasket grooves.
- 3.7.6 For glued gaskets, the cleaned groove shall have a heat-cured adhesive material applied and the gasket installed. The adhesive material must be compatible with the gasket and operating fluids. All plates with gaskets shall be stacked in a fixture to align the gaskets, placed under slight compression to remove air pockets, and heat

cured at a temperature recommended by the adhesive manufacturer. The curing time shall be at least three hours, but not less than the adhesive manufacturer's recommendation. Deformed gaskets must be replaced.

- 3.7.7 Gaskets shall furnish a double seal between heat transfer fluids. For those heat exchangers with welded plate pairs, the plenum between seals shall not have relieving grooves to atmosphere. Otherwise, this gasket plenum shall have relieving grooves such that all seal leaks are visually evident at the outside surface of the plate pack.
- 3.7.8 Gaskets shall be molded of one piece. For welded plate pairs, the Seller may close relieving grooves in separate molding steps.
- 3.7.9 Representative gaskets from each gasket production batch used in the exchanger shall be subjected to a hardness test, a compression set test, and a dimensional check prior to installation. Gasket hardness must be within 10% of the manufacturer's recommended hardness value.

3.8 Handling Devices

- 3.8.1 Provision for lifting the heat exchanger must be provided by permanent lifting lugs or frame holes, and shall be designed to support twice the maximum dry weight of the heat exchanger. Holes shall be no less than 1 inch in diameter.
- 3.8.2 If lifting lugs are provided, lifting lugs shall be a welded-on type with a machined hole.
- 3.8.3 If frame holes are provided, the hole shall be provided with a plug

4 Quality Assurance

4.1 General Requirements

- 4.1.1 The Seller's Quality Assurance Program (QAP) Requirements are included in 24590-WTP-3PS-G000-T0001, Supplier Quality Assurance Program.
- 4.1.2 Seller's QAP Manual shall be submitted to buyer for review in accordance with 24590-WTP-3PS-G000-T0001, Supplier Quality Assurance Program.
- 4.1.3 Seller's QAP, as a minimum, shall contain the requirements detailed in the Supplier Quality Assurance Program Requirements Data Sheets listed in Section 2 of the MR.

Appendix A Revision History

Paragraph	Revision A	Revision 0
2.1	Codes and Industry Standards American Society of Mechanical Engineers, Boiler and Pressure Vessel Code, Section VIII, Division I, Rules for Construction of Pressure Vessels	General 2.1.1 Work shall be done in accordance with the referenced codes, standards, and documents listed below, which are an integral part of this specification. 2.1.2 When specific chapters, sections, parts, or paragraphs are listed following a code, industry standard, or reference document, only those chapters, sections, parts, or paragraphs of the document are applicable and shall be applied. If a date or revision is not listed, the latest issue, including addenda, at the time of Request for Quote (RFQ) shall apply. When more than one code, standard, or referenced document covers the same topic, the requirements for all must be met with the most stringent governing.
2.2	Project Documents RPP-WTP Specification for Pressure Vessel Design and Fabrication, 24590-WTP-3PS-MV00-T0001	Codes 2.2.1 American Society of Mechanical Engineers, Boiler and Pressure Vessel Code, Section VIII, Division I, Rules for Construction of Pressure Vessels
2.3	None	Reference Documents/Drawings 2.3.1 RPP-WTP Specification for Pressure Vessel Design and Fabrication, 24590-WTP-3PS-MV00-T0001 2.3.2 RPP-WTP Specification for Supplier Quality Assurance Program Requirements, 24590-WTP-3PS-G000-T0001
3.2.3	After pressing, the minimum thickness of plates shall be 0.02 inch.	After pressing, the minimum thickness of plates shall be 0.024 inch.
3.3.5	All welded attachments to covers, including nameplate brackets, etc. shall be continuously welded to the covers. These welds shall be dye checked.	All welded attachments to covers, including nameplate brackets, etc. shall be continuously welded to the covers. These welds shall be examined by liquid penetrant method.
4.0	Quality Assurance Requirements The quality assurance requirements for the Seller are shown on the Supplier Quality Assurance Program Requirements Data Sheet attached to the Purchase Order.	Quality Assurance 4.1 General Requirements 4.1.1 The Seller's Quality Assurance Program (QAP) Requirements are included in 24590-WTP-3PS-G000-T0001, Supplier Quality Assurance Program. 4.1.2 Seller's QAP Manual shall be submitted to buyer for review in accordance with 24590-WTP-3PS-G000-T0001, Supplier Quality Assurance Program. 4.1.3 Seller's QAP, as a minimum, shall contain the requirements detailed in the Supplier Quality Assurance Program Requirements Data Sheets listed in Section 2 of the MR.